HPCC Year Two Progress Report
"A Distributed, Real-time Hurricane Wind Analysis System"
Hurricane Research Division NOAA/AOML, Miami, FL

The following is a progress report for the second year of a three year project entitled "A Distributed, Real-time Hurricane Wind Analysis System". The second year of this project has been funded by NOAA's High Performance Computing and Communications Program, with Matching funds provided through the FEMA-NIBS HAZUS Project.

Milestones and Deliverables (From Year 2 proposal)

1. **10-01-1999**
Completion of scripts for automated data transfer from space-, aircraft-, ocean-, and land-based observing systems using Local Data Manager (LDM).
2. **07-15-1999**
Prototype database schema design and evaluation versions of the database.
3. **11-01-1999**
Continue development of graphical, interactive, workstation/web version of analysis software (H*WIND). Provide software components to NHC for development of operational automated (non-interactive) version of analysis.
4. **12-01-1999**
Design of operational, research and Emergency Management (EM) products.
5. **09-15-1999**
Evaluation of Java-based workstation/web (alpha) versions of analysis at NHC, AOML.

* Year 2 of project commenced when the HPCC funds were received in March 1999.

Progress by Milestone

1. Completion of scripts for automated data transfer from space-, aircraft-, ocean-, and land-based observing systems using Local Data Manager (LDM).

Documentation:

As of March 2000, the following data are available to the system via LDM and our decoders: CMAN stations, buoys, ships, METAR data, GPS drops, SFMR data from the NOAA P3, and Vortex messages. Major additions this past year are satellite data from NESDIS including SSM/I, ERS-2, and QuikScat. Unfortunately there are no NOAA funds to perform a comprehensive evaluation of satellite surface wind products in tropical cyclones. We were not able to interest NASA in funding QuikScat evaluation. Most of the other data types that we need are already available through the LDM system, and decoders and scripts have been written for most of them. We have also reused the HRD java packages to meet some of our decoding and adjustment needs, thereby minimizing bugs and testing time. We still need to complete

an updated version of our boundary layer (mbl) winds to the surface. Recent work conducted at HRD is focused on improving our ability to adjust upper level winds to the surface based on new data sets from the 2000 season.

2. Prototype database schema design and evaluation versions of the database.

Documentation:

Work is complete on a database schema under an Oracle 8 and Oracle 8i Object Relational DBMS. The schema is based on the Masters Thesis* of the project's database administrator and database developer. We are currently using the database schema for preliminary testing and evaluation of H*WIND. The new system will begin daily evaluation trials in May 2000. A book describing the database implementation of H*WIND has been published November 1999 "Oracle 8i SQL/J Programming" by Nirva Morisseau-Leroy, M. Solomon, G. Momplaisir. Another book describing the database implementation as Enterprise Java Beans, and Corba Objects in an Oracle 8i data server is scheduled to be published in Aug. 2000.

*Morisseau-Leroy, N., Atmospheric Observations, Analyses, and The World Wide Web Using a Semantic Database, Master Thesis, School of Computer Sciences, Florida International University, Miami, FL, 1997

3. Continue development of graphical, interactive, workstation/web version of analysis software (H*WIND). Provide software components to NHC for development of operational automated (non-interactive) version of analysis.

Documentation:

Development for both the QCClient and Analysis Automation subsystems of the new system is ongoing and progressing steadily and is undergoing interactive Quality Assurance testing. In general, all code is up to date with latest JAVA Development Kit (jdk) release (java 2) and implementation of most functionality is complete including database integration. The QCClient design is described in Luis Amat's Masters Thesis : Amat, Jr., L. R., A Real-time Internet Based Quality Control Application for Hurricane Surface Wind Observations, Master Thesis, School of Computer Sciences, Florida International University, Miami, FL, 1998.

Sonia Otero has undertaken completion of the H*WIND client implementation by thoroughly testing, debugging and optimizing Luis Amat's implementation (the previous developer). Most of the client application sub system and analysis sub system functionality requirements have been met. Some of the requirements for the QCClient application include: 1) map loading and drawing on any given basin, 2) plotting of wind observations and storm track fixes in both synoptic and storm relative coordinates, 3) graphical tools such as zooming, observation flagging (quality control), distance/heading calculation and detailed observation inspection and editing, 4) separate "views" panel for immediate graphical response to any changes to data, and 5) file import and export capabilities for legacy data files, landmarks files, and

GIS files.

QCClient's complete database integration allows efficient observation querying based on time span, platform data source and basin, and storm fix or complete track querying for a specific event. Events are also stored in the database with the ability to set transformations from one event to another. The user can now commit to the database an entire quality control session for later research (i.e. store all observations and fixes involved in the evaluation of a specific event).

The Analysis sub system most important critical requirements have been met: 1) conversion of the FORTRAN in-house analysis algorithm code to libraries loadable in Java, and 2) integration of analysis scheduling within the QCClient application. As soon as the QCClient sub system, currently undergoing user beta-testing process, reaches a more refined state, Sonia Otero will be able to proceed with the implementation of database storage/retrieval of the analysis results and the object distribution of the analysis via CORBA (Common Object Request Broker Architecture) and RMI (Remote Method Invocation) communication approaches.

The process of losing a key member of the programming team (Luis) to the corporate world and bringing in a new programming team leader (Sonia) has prevented us from conducting work on the web version of H*WIND. A web browser version of H*WIND would be possible with one year of additional funding.

The NHC scientist originally interested in automating the analysis (Dr. DeMaria) has taken another position at the NOAA/NESDIS cooperative institute at Colorado State University. Since we need to maintain direct interaction with NHC, Dr. Edward Rappaport, chief of the Technical Support Branch (http://www.nhc.noaa.gov/abouttsb.html) of the Tropical Prediction Center / NHC, will replace Dr. DeMaria as the NHC PI on this project. NHC does not presently have the programming staff required to develop and maintain an automated version of the wind analysis system. Automating the wind analysis is a long term goal and would involve aspects of variational data assimilation, expert systems, and possibly neural net technology. The best way to accomplish automation would be through a season of testing side by side with the interactive H*WIND at NHC/AOML. Once H*WIND is completed and updated after a year of evaluation in NHC's operational environment, we will seek funding to work on the automation process in the 2001 proposal process. Included with that request will be the design of products for wireless information devices using WAP or related technology. This information will be of great use to emergency managers and decision makers in areas without normal communications following a disaster.

4. Design of forecast, research, and Emergency Management (EM) products.

Documentation:

The PI and members of the H*WIND development team attended the HAZUS Users Workshop conducted in April, 1999 in Miami Beach (representative users from the emergency management, local government, and utilities discussed features required from the HAZUS wind module to serve as a disaster

mitigation and planning tool). Based on feedback from the workshop, we have started work on creating GIS readable file versions of HRD's products. We currently have ways to read arbitrary "shape files" (an Arc View file format) in C and C++ as well as ways to read and display shape files in JAVA. Our work on shape file generation is not complete, but we should have working tools by late 2000.

Work on product generation routines will be completed in concert with the demand for new products. We have completed development on the subset of routines that represents the products that HRD had available in real-time in previous years. All the routines are now implemented in Research System Inc.'s (RSI) Interactive Data Language (IDL). The routines are capable of plotting images to a local screen and/or generating images in a variety of file formats for delivery as hard copies. We are investigating different methods of delivering dynamically generated IDL products over the web. Both CGI and Java based methods are possible, but software licensing, product delivery speed and the intricacy of the code are still issues to be resolved for each proposed method. Dr. Powell will be presenting several prototype products to emergency managers during his presentation at the National Hurricane Conference in New Orleans, April 19, 2000.

5. Evaluation Workstation/Web (interactive) versions of analysis at NHC, AOML

Documentation:

This milestone combines a great deal of work contained within other milestones, and therefore requires that most of those milestones be met. As of March 2000, the Oracle database software for our NHC server has been installed and tested. We will test the interactive version of the H*WIND system before the 2000 Atlantic Hurricane season by examining late season systems in the South Pacific and Indian Ocean in April and May 2000. During the 1999 season, over 200 real-time wind analyses (a new record) were conducted and for the first time, real-time analyses were transmitted to the Central Pacific Hurricane Season for Hurricanes Dora and Eugene. HRD scientists worked shifts to conduct analyses at 3-6 h intervals during landfall situations. Many of these analyses were conducted at NHC where we were able to interact with NHC forecasters while providing valuable guidance and gaining important feedback on how to improve our products. Gridded wind field products were created in real time and made available to the scientific community through a secure ftp account. Analyses were placed on the HRD Storm Atlas and made available to the public after a 24 h lag. The reason for the lag is to lessen the chance for confusion among the public associated with the storm intensity.

Staff Changes

Luis Amat took a position with Oracle in July, 1999. We are grateful for all the effort Luis put into leading the development of H*WIND as our main software engineer. The experience gained working on this project enabled him to obtain a very lucrative position outside government. Sonia Otero (a masters student in computer science at Florida International University) and Nicholas Carrasco (a Computer engineering student at University of Miami) will replace Luis. Both have been involved in the project on a part-time basis for 2 years and will now work a flexible full time schedule while continuing their

studies.

Staff

Awards

Publications

Conference Presentations

Funded by NOAA High Performance Computing and Communications (HPCC)